

Hydrogen Safety

Like any fuel, including gasoline and natural gas, hydrogen is an energetic substance and must be handled appropriately to ensure safety. The characteristics of hydrogen are different (just like gasoline differs from natural gas) and a number of its properties are advantageous with regard to safety. Hydrogen can be used as safely as other common fuels we use today when guidelines are observed and users understand its behavior.

The Facts of Hydrogen Safety

- ▶ As the lightest and smallest element in the universe, confining hydrogen is very difficult. Hydrogen is much lighter than air and rises at a speed of almost 20 meters per second — two times faster than helium and six times faster than natural gas — which means that when released, it rises and dilutes quickly.
- ▶ Combustion cannot occur in a tank or any contained location that contains only hydrogen. An oxidizer, such as oxygen, must be present.
- ▶ Hydrogen is odorless, colorless, and tasteless and therefore undetectable by human senses. For these and other reasons, industry uses hydrogen sensors to detect hydrogen leaks. Natural gas is also odorless, colorless, and tasteless, but industry adds a sulfur-containing odorant so people can detect it. These odorants cannot be used with hydrogen, however, because they contaminate fuel cells, a popular hydrogen application.
- ▶ Hydrogen burns very quickly. Under optimal combustion conditions, the energy required to initiate hydrogen combustion is significantly lower than that required for other common fuels, such as natural gas or gasoline. At low concentrations of hydrogen fuel in air, the energy required to initiate combustion is similar to that of other fuels.
- ▶ Hydrogen flames have low radiant heat. A hydrogen fire has significantly less radiant heat when compared to a hydrocarbon fire. Since low levels of heat are emitted near a hydrogen flame (the flame itself is just as hot), the risk of secondary fires is lower.
- ▶ With the exception of oxygen, any gas can cause asphyxiation in high enough concentrations. In most scenarios, however, because hydrogen rises and diffuses so rapidly, it is unlikely to be confined where asphyxiation might otherwise occur.
- ▶ Hydrogen is non-toxic and non-poisonous. It will not contaminate groundwater (it's a gas under normal atmospheric conditions), and a release of hydrogen is not known to contribute to atmospheric pollution or water pollution.

Hydrogen refueling systems are designed with the unique properties of hydrogen in mind; special safety features like this closed system, high-pressure nozzle help to ensure safe refueling and prevent unintended releases.

Photo courtesy of DaimlerChrysler



Safety Research

Researchers in government, industry, and academia are also working to:

- ▶ Further analyze critical hydrogen behavior data;
- ▶ Develop reliable, inexpensive hydrogen sensor and leak detection technologies; and
- ▶ Identify tools and methodologies to support the development of hydrogen codes and standards.

Codes and Standards

Hydrogen codes and standards are being developed to provide the information needed to safely build, maintain, and operate hydrogen and fuel cell systems and facilities, ensure uniformity of safety requirements, and provide local officials and safety inspectors with the information needed to certify hydrogen systems and installations.

Did you know...

Hydrogen is an energy carrier, not an energy source, meaning that it stores and delivers energy in a usable form.

Hydrogen can be produced using abundant and diverse domestic energy resources, including fossil fuels, such as natural gas and coal; renewable energy resources, such as solar, wind, and biomass; and nuclear energy.

A hydrogen economy would not only reduce our dependence on imported oil, but also benefit the environment by reducing emissions of greenhouse gases and criteria pollutants that affect our air quality.

The President's Hydrogen Fuel Initiative accelerates the research and development of hydrogen, fuel cell, and infrastructure technologies that would enable hydrogen fuel cell vehicles to begin to reach the commercial market in the 2020 timeframe.

Under President's Hydrogen Fuel Initiative, the DOE Hydrogen Program works with industry, academia, national laboratories, and other federal and international agencies to overcome critical technology barriers, address safety issues and facilitate the development of model codes and standards, validate hydrogen fuel cell technologies in real world conditions, and educate key stakeholders in the transition to a hydrogen economy.

A Record of Safety

The United States currently produces and safely uses more than nine million metric tons of hydrogen each year (enough hydrogen to fuel more than 35 million cars). Industry considers the unique properties of hydrogen when designing structures where it will be used and stored. Components are built to meet strict guidelines and undergo third-party certification for safety and structural integrity.

As the technology develops and the number of demonstration projects increases, and as hydrogen moves into the mainstream public, education and training will become even more critical. Emergency personnel must be prepared to handle potential incidents, and public education to familiarize users with simple hydrogen safety practices will help to ensure a continued record of hydrogen safety.



Photo courtesy of the CAFCP

Compressed
HYDROGEN

In addition to company-specific logos and markings, auto manufacturers use this common blue logo to identify their hydrogen fueled vehicles.